STATE OF MAINE

DEPARTMENT OF TRANSPORTATION

TRANSPORTATION RESEARCH DIVISION
BUREAU OF PLANNING, RESEARCH & COMMUNITY SERVICES

DATE May 1998

EXPERIMENTAL CONSTRUCTION 92-34

FIELD TRIAL OF GRAVEL STABILIZATION METHODS
ROUTE 1, CYR-VAN BUREN, MAINE

5TH INTERIM REPORT

INTRODUCTION

This experimental construction project was developed, designed, and inspected by personnel from the University of Maine, Civil Engineering Staff The experimental project was constructed on and as a part of Project #2586 00 This was a complete reconstruction project 3 54 km (2 2 mi) in length The experimental section contains 6 experimental base types and is 310 m (1020 ft) in length The experimental section began at Station 1028+00 and ended at Station 1038+20 The test section consisted of 60 m (200 ft) segments of soil cement, asphalt, calcium chloride, modified, standard and one 6 m (20 ft) untreated section The stabilized and control sections were located as follows

Soil-Cement Stabilized	STA 1028+00 to 1030+00
Modified Subbase Control	STA 1030+00 to 1032+00
Asphalt Stabilized Section	STA 1032+00 to 1034+00
Untreated Section	STA 1034+00 to 1034+20
Calcium Chloride Stab Section	STA 1034+20 to 1036+20
Standard Subbase Control	STA 1036+20 to 1038+20

The Soil Cement Stabilized section is a mixture of Modified Subbase (mentioned later) and 6 percent by weight of Type I Portland Cement

The Modified Subbase Control section is standard subbase aggregate MDOT specification 703 06b Type D with a 5 1 cm (2 in) maximum aggregate size This aggregate was used on all stabilized sections to facilitate blending of each treatment

The Asphalt Stabilized section is a mixture of modified subbase and 4 5 percent of MS-4 Emulsified Asphalt

The Untreated section consists of Modified Subbase

The Calcium Chloride Stabilized section is a mixture of Modified Subbase and 2 8 l/m^2 (0 75 gal/yd^2) of 35 percent liquid calcium chloride solution

The Standard Subbase Control section consists of standard subbase aggregate MDOT specification 703 06b Type D with a 15 2 cm (6in) maximum aggregate size

Construction on this project started in September 1990 and was completed in the summer of 1991 A background of the stabilization agents, their uses, advantages and disadvantages is explained in the construction report titled "Experimental Construction 92-34" written in December 1991 This report also provided preliminary design results as well as test results obtained during construction In addition to the test results a plan for long term monitoring was also included in Appendix G and reproduced for this report in Table I Some of the features to be monitored are rutting and serviceability, such as roughness and overall performance Strength measurements using pavement deflection was also suggested Most of the evaluations can be performed with the Automatic Road ANalyzer (ARAN) and Falling Weight Deflectometer test vehicles Long term monitoring of the calcium chloride is specifically mentioned For this phase they recommend boring test holes and sampling the base every 5th year to monitor the possibility of leaching calcium chloride

RESULTS

This report covers the period of time from January thru December 1997 According to the test schedule in Table I, roughness, rut depths, pavement deflections, elevation, profile and crack survey data were obtained

ROUGHNESS MEASUREMENTS

The ARAN was used to measure roughness, this is a response type roughness measuring device using two accelerometers, the first attached to the floor of the vehicle the second mounted on the rear axle directly below the first The results are presented in Table II using International Roughness Index (IRI) values Tests have revealed the following

In the northbound lane, the Standard Subbase continues to be the smoothest section with a decrease in values compared to last year The Soil Cement and Calcium Chloride sections are slightly rougher than the Standard Subbase The Asphalt Stabilized section continues to be the roughest followed by the Modified Subbase section

In the southbound lane, the Standard Subbase continues to be the smoothest section with a slight decrease in values from last year The Soil Cement section is the roughest with a slight increase in values from last year followed by the Modified Subbase, Asphalt Stabilized and Calcium Chloride sections

Overall the Standard Subbase section continues to be the smoothest, but values for the remaining sections indicate very little movement within the experimental area Although the test sections are rather short for measuring roughness accurately, the IRI for all test sections are relatively unchanged from last year and they are performing within the smooth rating of 0-3 m/km (0-190 in/mi)

RUT DEPTH MEASUREMENTS

The ARAN was also used to measure rut depths Ultrasonic sensors are spaced 10 cm (4 in) apart on a 3 7 m (12 ft) wide smartbar (front bumper) These sensors record distance from the smartbar to the pavement surface Gyroscopes are used to record pitch and roll of the vehicle at each station to determine the pavement slope Depths are measured to the nearest 0 25 cm (0 1 in) Average values for inner and outer wheelpaths per lane per test section are presented in Table III Tests have revealed the following

The outer wheelpath is increasing in rut depth

The Calcium Chloride section has increased rut depths in both wheelpaths

There is very little change in rut depths throughout the project and these changes are normal for a project of this age

STRUCTURAL MEASUREMENTS

In previous years, MDOT used the Road Rater to record structural measurements This past year MDOT purchased a Falling Weight Deflectometer (FWD) to replace the Road Rater Measurements from the Road Rater and FWD are reported in Table IV

Road Rater results are displayed as an overlay required This is the depth of overlay necessary to restore each section to a 20 year design life using 61 cm (24 in) of subbase and 15 cm (6 in) of pavement, the lower the number the stronger the section All readings are negative suggesting no overlay is necessary

The FWD calculates an effective existing pavement structural number This number is calculated using measurements from the first sensor and represents the existing structural number for 61 cm (24 in) of subbase and 15 cm (6 in) of pavement combined, the higher the number the stronger the section Similar roads of this design in the state of Maine have a structural number between 5 and 6

Deflections have revealed the following

All sections have higher structural readings this season and are performing normally for a project of this age

The Soil Cement section continues to outperform all sections

The Modified and Calcium Chloride sections have similar readings These sections are structurally lower than the Standard Subbase

The Asphalt section is showing greater strength than the Standard Subbase section

Results from the FWD are following the same pattern as Road Rater results for each section

PROFILE and ELEVATION MEASUREMENTS

Profile and elevation measurements were recorded every 30 m (100 ft) from station 1028+50 to 1037+50 Results, presented in Table V, reveal very little movement within each section

VISUAL EVALUATION

Visual inspection and a crack survey of the project were conducted for this report The results are as follows

The Modified Subbase, Asphalt Stabilized and Calcium Chloride Stabilized sections have full length centerline joint separation Soil Cement centerline separation increased from 15 m (50 ft) to 21 m (70 ft) and the Standard Subbase increased from 38 m (125 ft) to 52 m (170 ft)

All sections had shoulder joint separation The Soil Cement increased from 0 to 33 m (110 ft), Modified Subbase increased from 13 m (42 ft) to 55 m (182 ft), Asphalt Stabilized from 52 m (170 ft) to 85 m (280 ft), Calcium Chloride remained the same at 46 m (150 ft) and the Standard Subbase increased from 11 m (35 ft) to 21m (70 ft)

Each section has transverse cracking The Soil cement section has two full width cracks and a new 1 m (4 ft) crack developing from centerline at sta 1028+50 The Modified Subbase area hasn't changed from the last evaluation with one full width crack at sta 1031+46 The Asphalt Stabilized area has two transverse cracks, as reported in the 3rd interim, one full width and one half width The half width crack is located in the northbound lane and is migrating 2 m (5 ft) into the southbound lane There is no change in the Calcium Chloride and Standard Subbase sections, each with one full width crack

In the 3rd interim report the Calcium Chloride section had 34 m (110 ft) of longitudinal cracking between wheel paths in the southbound lane This evaluation has revealed an additional 9 m (30 ft) of similar cracking in the northbound lane No other sections are experiencing cracking of this type

Asphalt flushing is still evident in the same five areas as reported in the 3rd interim report with no additional areas developing

RECOMMENDATIONS

Although the initial rut depths for the Soil Cement section were high, due to the increased stability of the base material and traffic flow on the surface course shortly after construction, this treatment is showing improved stability compared to the Standard Subbase control section and is recommended for use as a stabilizing agent

Asphalt Stabilized base material is also showing an increase in stability over the Standard Subbase Control section and is recommended as an additive

The Modified Subbase treatment is not recommended at this time due to the low structural readings as compared to the control section

The Calcium Chloride section is the only area showing pavement distress with longitudinal cracking between wheelpaths This section also has low structural readings and is not recommended as a stabilizing agent

Since the Calcium Chloride section is not recommended as a stabilizing agent, the CaCL2 leach test will be discontinued

Due to the relatively small changes in elevation and profile, these measurements will be discontinued for the remainder of this study

The remaining tests are recording very little change from year to year as well, for this reason we are updating the test schedule to collect IRI, Rut Depths and Pavement Deflections biennially with a Visual Evaluation every year The Visual Evaluation will be used to determine if tests are warranted in the off years

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Distribution B

Other Available Documents

Construction Report December 1991
1st Interim Report May 1993
2nd Interim Report February 1995
3rd Interim Report January 1996
4th Interim Report January 1997

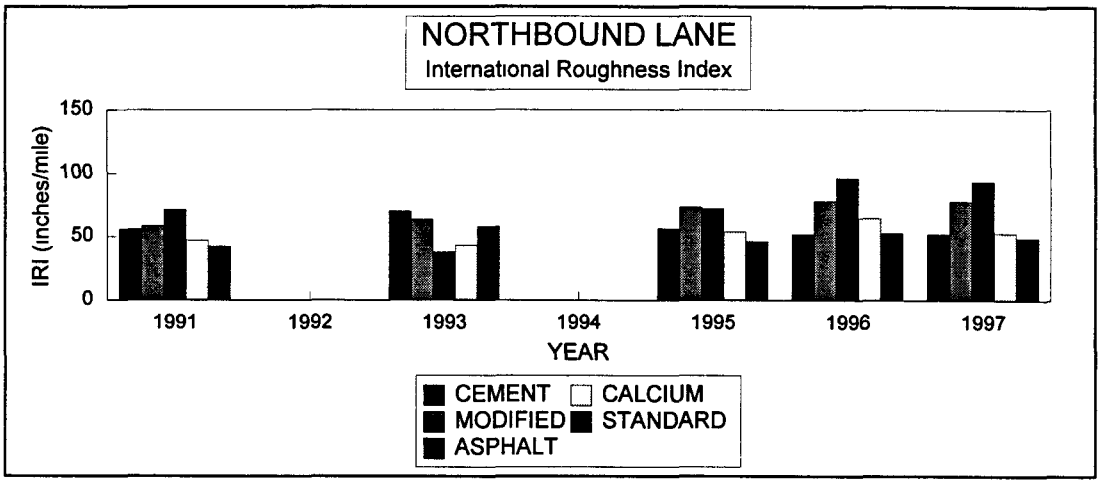
TABLE I
TESTING SCHEDULE FOR CYR - VAN BUREN
FIELD TRIAL OF
GRAVEL STABILIZATION METHODS

YEAR	ARAN Roughness IRI	ARAN Rut	Pavement Deflections	Elev X-sections	Elev Profile	Crack Survey	CaCl2 Leach
1991	*	*	*				
1992	*	*	*	*	*	*	
1993	*	*	*	*	*	*	
1994	*	*	*				
1995	*	*	*	*	*	*	*
1996	*	*	*				
1997	*	*	*	*	*	*	
1998	*	*	*				
1999	*	*	*	*	*	*	
2000	*	*	*				*
2001	*	*	*	*	*	*	
2002	*	*	*				
2003	*	*	*	*	*	*	
2004	*	*	*				
2005	*	*	*	*	*	*	*
2006	*	*	*				

TABLE II
PHYSICAL PROPERTIES
INTERNATIONAL ROUGHNESS INDEX (Inches / Mile)

NORTHBOUND LANE

DATE	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT STABILIZED	CALCIUM CHLORIDE	STANDARD SUBBASE
1991	55 67	58 09	70 97	47 09	42 23
1992	M	M	M	M	M
1993	69 98	63 40	37 88	43 07	57 66
1994	M	M	M	M	M
1995	56 03	73 09	72 18	53 61	46 11
1996	51 65	77 89	96 14	64 55	52 50
1997	51 75	77 62	93 30	52 48	48 64



SOUTHBOUND LANE

DATE	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT STABILIZED	CALCIUM CHLORIDE	STANDARD SUBBASE
1991	M	M	M	M	M
1992	M	M	M	M	M
1993	M	M	M	M	M
1994	M	M	M	M	M
1995	82 05	61 53	68 22	61 35	40 67
1996	78 57	69 45	70 49	67 24	50 15
1997	85 39	75 04	67 99	59 75	42 99

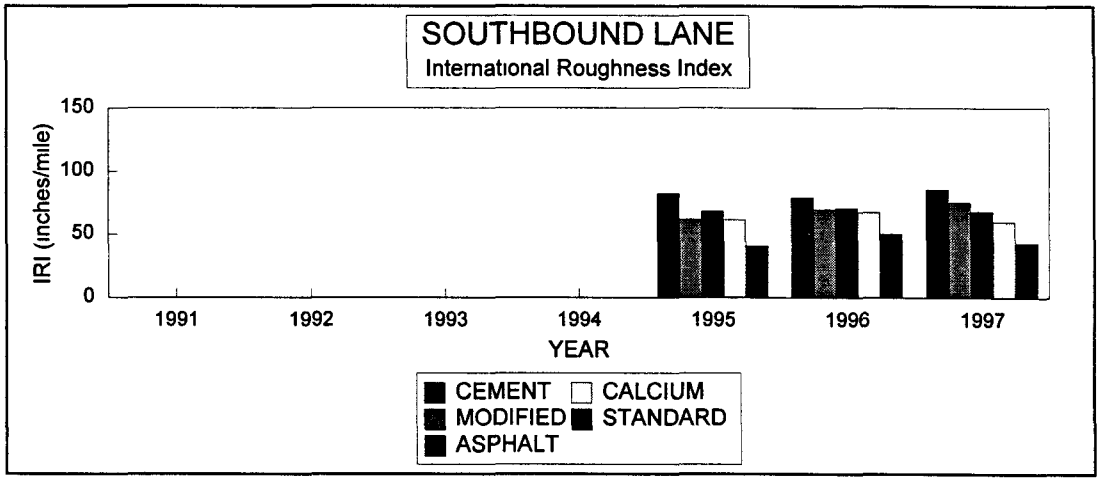


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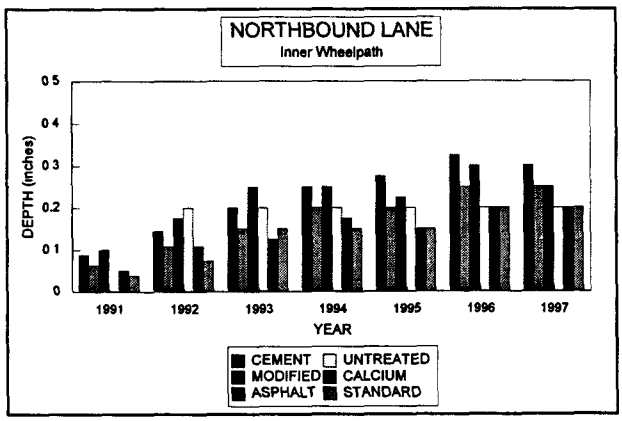
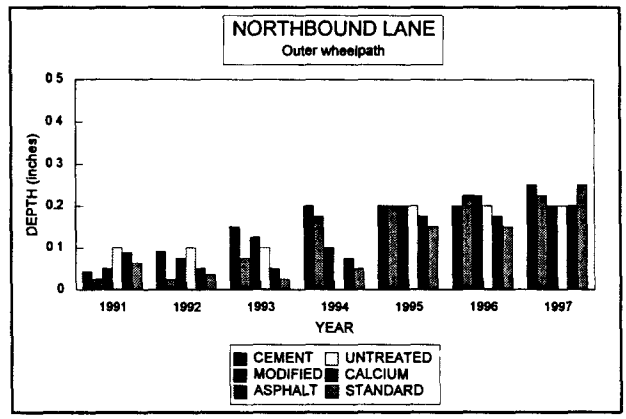
TABLE III
PHYSICAL PROPERTIES
AVERAGE RUT DEPTHS (Inches)

NORTHBOUND LANE

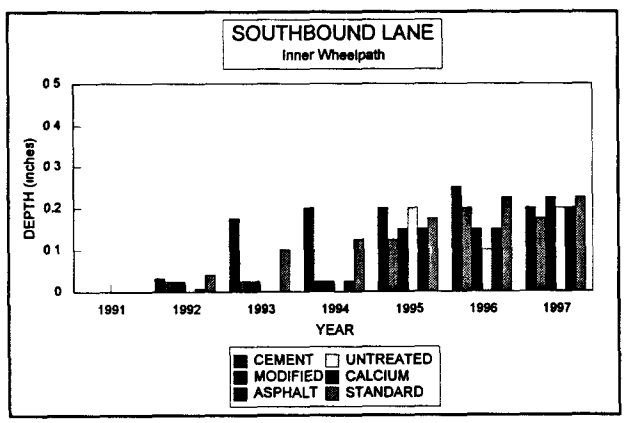
	Inner Wheelpath						Outer wheelpath					
DATE	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT SUBBASE	UN TREATED	CALCIUM CHLORIDE	STANDARD SUBBASE	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT SUBBASE	UN TREATED	CALCIUM CHLORIDE	STANDARD SUBBASE
1991	0 088	0 063	0 100	0 000	0 050	0 038	0 043	0 025	0 050	0 100	0 088	0 063
1992	0 145	0 108	0 175	0 200	0 108	0 073	0 091	0 025	0 075	0 100	0 050	0 036
1993	0 200	0 150	0 250	0 200	0 125	0 150	0 150	0 075	0 125	0 100	0 050	0 025
1994	0 250	0 200	0 250	0 200	0 175	0 150	0 200	0 175	0 100	0 000	0 075	0 050
1995	0 275	0 200	0 225	0 200	0 150	0 150	0 200	0 200	0 200	0 200	0 175	0 150
1996	0 325	0 250	0 300	0 200	0 200	0 200	0 200	0 225	0 225	0 200	0 175	0 150
1997	0 300	0 250	0 250	0 200	0 200	0 200	0 250	0 225	0 200	0 200	0 200	0 250





SOUTHBOUND LANE

	Inner Wheelpath						Outer wheelpath					
DATE	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT SUBBASE	UN TREATED	CALCIUM CHLORIDE	STANDARD SUBBASE	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT SUBBASE	UN TREATED	CALCIUM CHLORIDE	STANDARD SUBBASE
1991	M	M	M	M	M	M	M	M	M	M	M	M
1992	0 033	0 025	0 025	0 000	0 008	0 040	0 083	0 092	0 067	0 000	0 033	0 080
1993	0 175	0 025	0 025	0 000	0 000	0 100	0 100	0 025	0 050	0 000	0 000	0 150
1994	0 200	0 025	0 025	0 000	0 025	0 125	0 100	0 100	0 100	0 200	0 100	0 150
1995	0 200	0 125	0 150	0 200	0 150	0 175	0 200	0 200	0 200	0 100	0 150	0 200
1996	0 250	0 200	0 150	0 100	0 150	0 225	0 175	0 150	0 150	0 200	0 125	0 175
1997	0 200	0 175	0.225	0 200	0 200	0 225	0 225	0 200	0 200	0 200	0 200	0 200



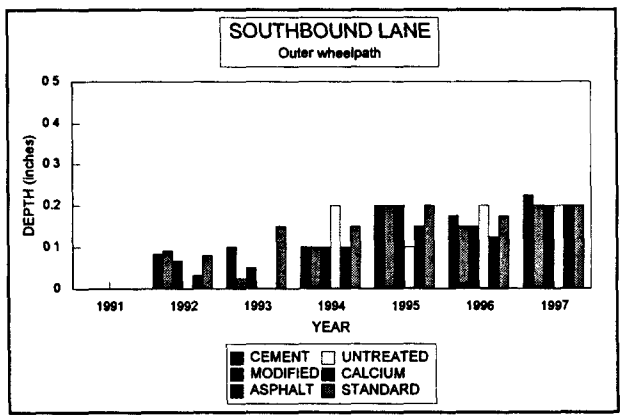


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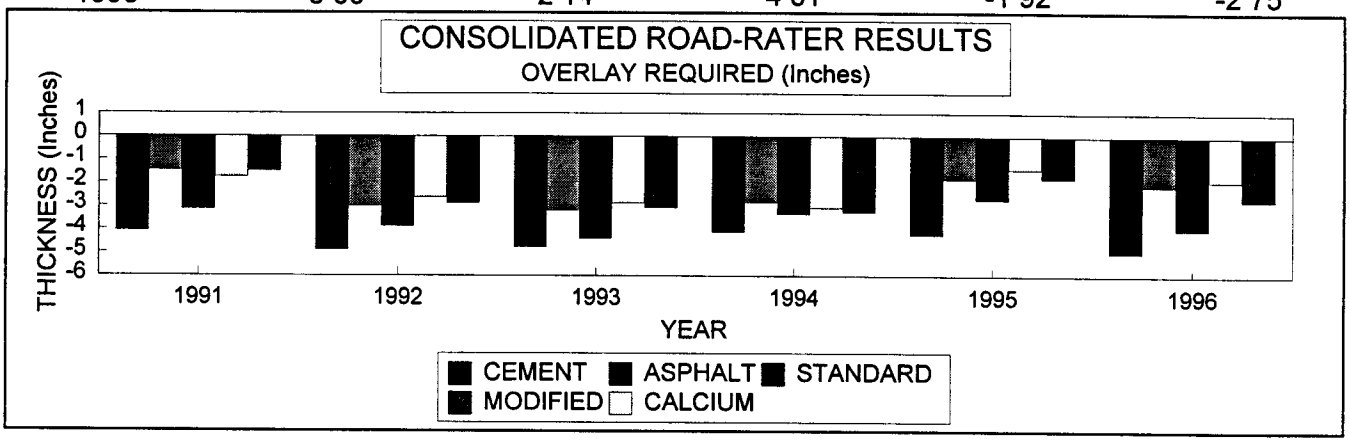
TABLE IV
PHYSICAL PROPERTIES
STRUCTURAL EVALUATION

CONSOLIDATED ROAD-RATER RESULTS
OVERLAY REQUIRED (Inches)

YEAR	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT STABILIZED	CALCIUM CHLORIDE	STANDARD SUBBASE
1991	-4 11	-1 50	-3 19	-1 78	-1 52
1992	-4 90	-3 03	-3 90	-2 66	-2 91
1993	-4 78	-3 21	-4 41	-2 89	-3 08
1994	-4 14	-2 85	-3 35	-3 08	-3 27
1995	-4 24	-1 85	-2 72	-1 42	-1 80
1996	-5 00	-2 14	-4 01	-1 92	-2 75



CONSOLIDATED FALLING WEIGHT DEFLECTOMETER RESULTS
EFFECTIVE EXISTING PAVEMENT STRUCTURAL NUMBER

YEAR	SOIL CEMENT	MODIFIED SUBBASE	ASPHALT STABILIZED	CALCIUM CHLORIDE	STANDARD SUBBASE
1997	7 32	6 41	6 78	6 46	6 55

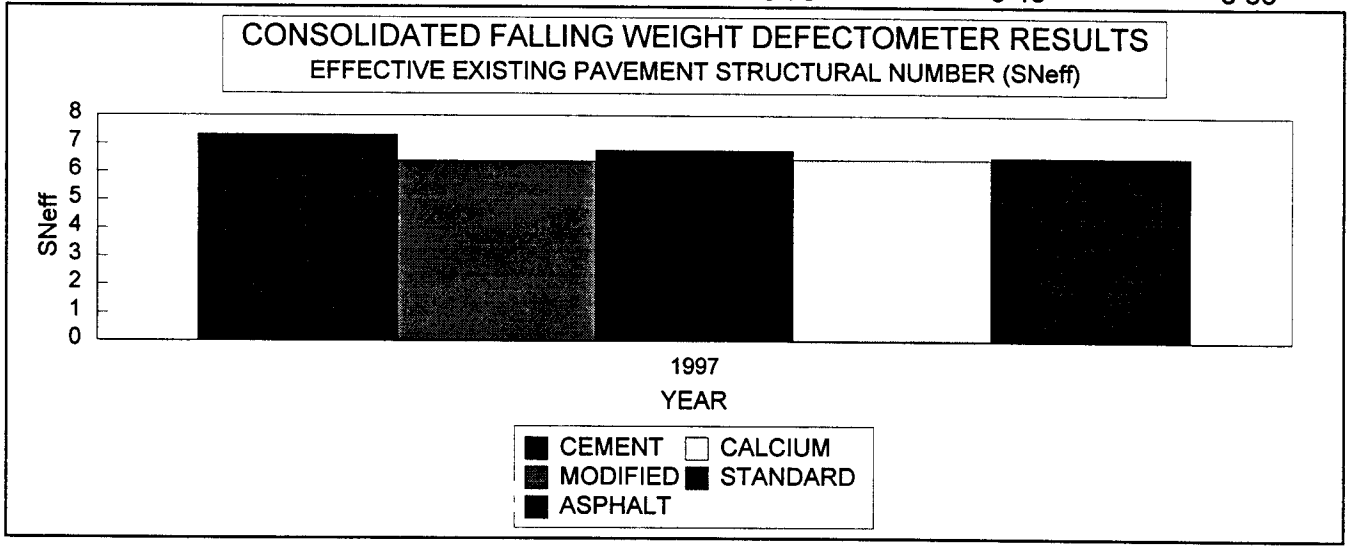
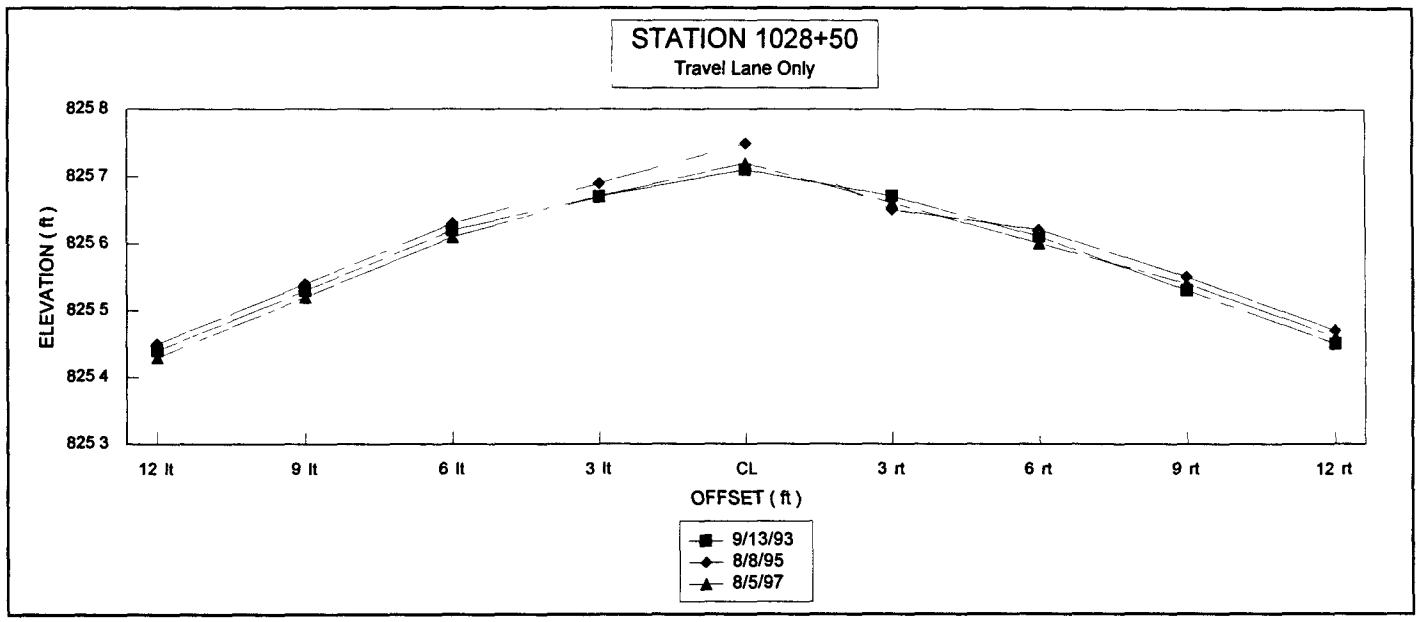


TABLE V
MDOT PROFILE AND ELEVATION SURVEY

SOIL CEMENT STABILIZED SECTION
STATION 1028+50

DATE	22' lt	12' lt	9' lt	6' lt	3' lt	CL	3' rt	6' rt.	9' rt.	12' rt	22' rt.
8/22/91	825 01	825 45	M	M	M	825 75	M	M	M	825 51	825 05
6/30/92	825 01	825 43	M	M	M	825 74	M	M	M	825 48	825 03
9/13/93	825 01	825 44	825 53	825 62	825 67	825 71	825 67	825 61	825 53	825 45	825 01
8/8/95	825 05	825 45	825 54	825 63	825 69	825 75	825 65	825 62	825 55	825 47	825 04
8/5/97	825 04	825 43	825 52	825 61	825 67	825 72	825 66	825 60	825 54	825 46	825 02



STATION 1029+50

DATE	22' lt.	12' lt.	9' lt.	6' lt.	3' lt.	CL	3' rt.	6' rt.	9' rt.	12' rt.	22' rt.
8/22/91	824 81	825 13	M	M	M	825 41	M	M	M	825 17	824 73
6/30/92	824 79	825 11	M	M	M	825 38	M	M	M	825 13	824 72
9/13/93	824 77	825 13	825 21	825 28	825 33	825 37	825 33	825 28	825 20	825 11	824 71
8/8/95	824 83	825 14	825 22	825 30	825 35	825 40	825 34	825 29	825 22	825 13	824 71
8/5/97	824 81	825 11	825 19	825 28	825 32	825 37	825 32	825 28	825 20	825 11	824 70

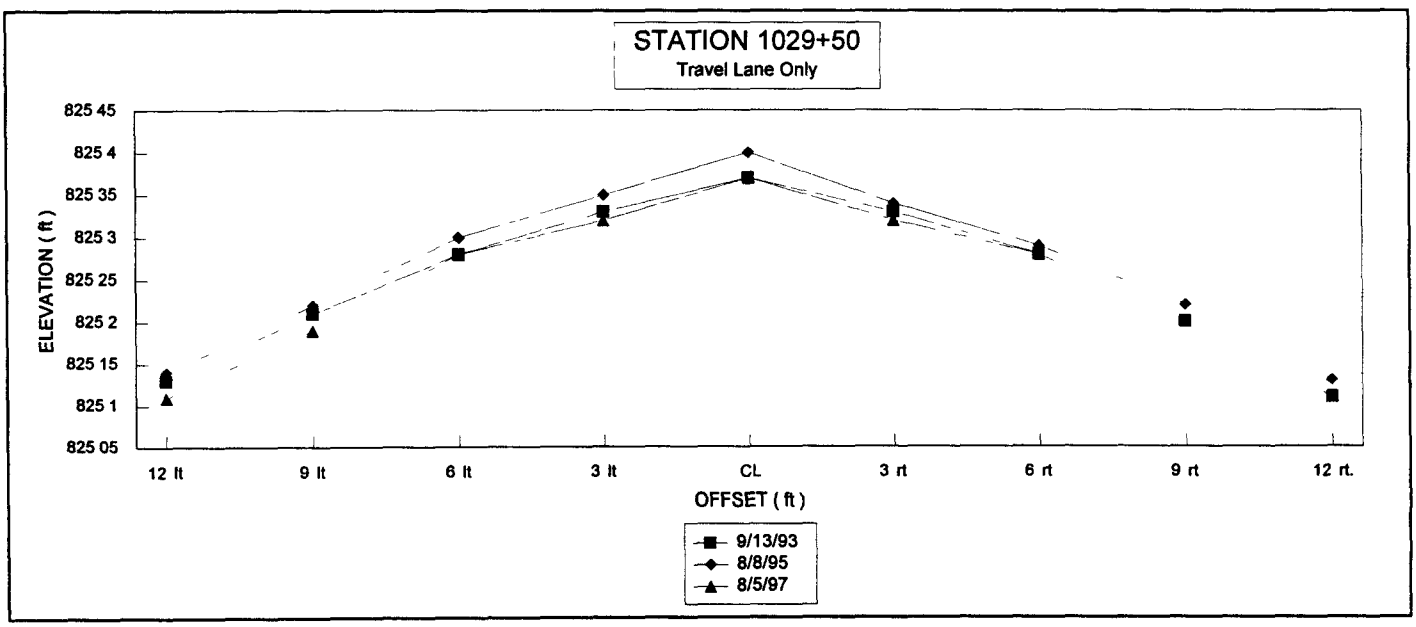


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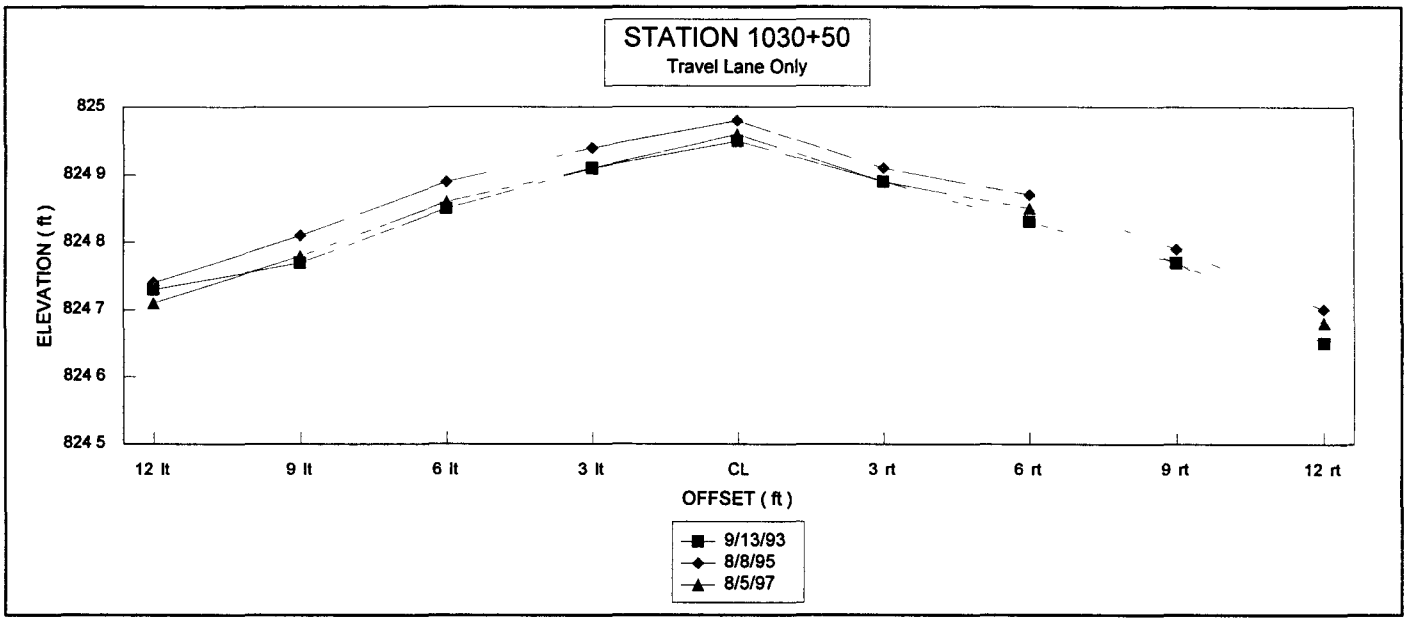
TABLE V
MDOT PROFILE AND ELEVATION SURVEY
(continued)
MODIFIED SUBBASE CONTROL SECTION
STATION 1030+50

DATE	22' lt	12' lt	9' lt	6' lt	3' lt	CL	3' rt	6' rt.	9' rt	12' rt	22' rt.
8/22/91	824 31	824 71	M	M	M	824 99	M	M	M	824 71	824 31
6/30/92	824 33	824 71	M	M	M	824 96	M	M	M	824 69	824 27
9/13/93	824 29	824 73	824 77	824 85	824 91	824 95	824 89	824 83	824 77	824 65	824 23
8/8/95	824 34	824 74	824 81	824 89	824 94	824 98	824 91	824 87	824 79	824 70	824 28
8/5/97	824 32	824 71	824 78	824 86	824 91	824 96	824 89	824 85	824 77	824 68	824 26



STATION 1031+50

DATE	22' lt.	12' lt.	9' lt.	6' lt	3' lt.	CL	3' rt.	6' rt	9' rt	12' rt.	22' rt.
8/22/91	824 02	824 40	M	M	M	824 66	M	M	M	824 38	823 96
6/30/92	823 99	824 37	M	M	M	824 65	M	M	M	824 37	823 96
9/13/93	823 96	824 36	824 44	824 52	824 58	824 63	824 58	824 52	824 44	824 35	823 94
8/8/95	824 02	824 40	824 48	824 56	824 61	824 67	824 61	824 57	824 44	824 37	823 95
8/5/97	824 02	824 38	824 45	824 55	824 59	824 64	824 58	824 54	824 43	824 35	823 92

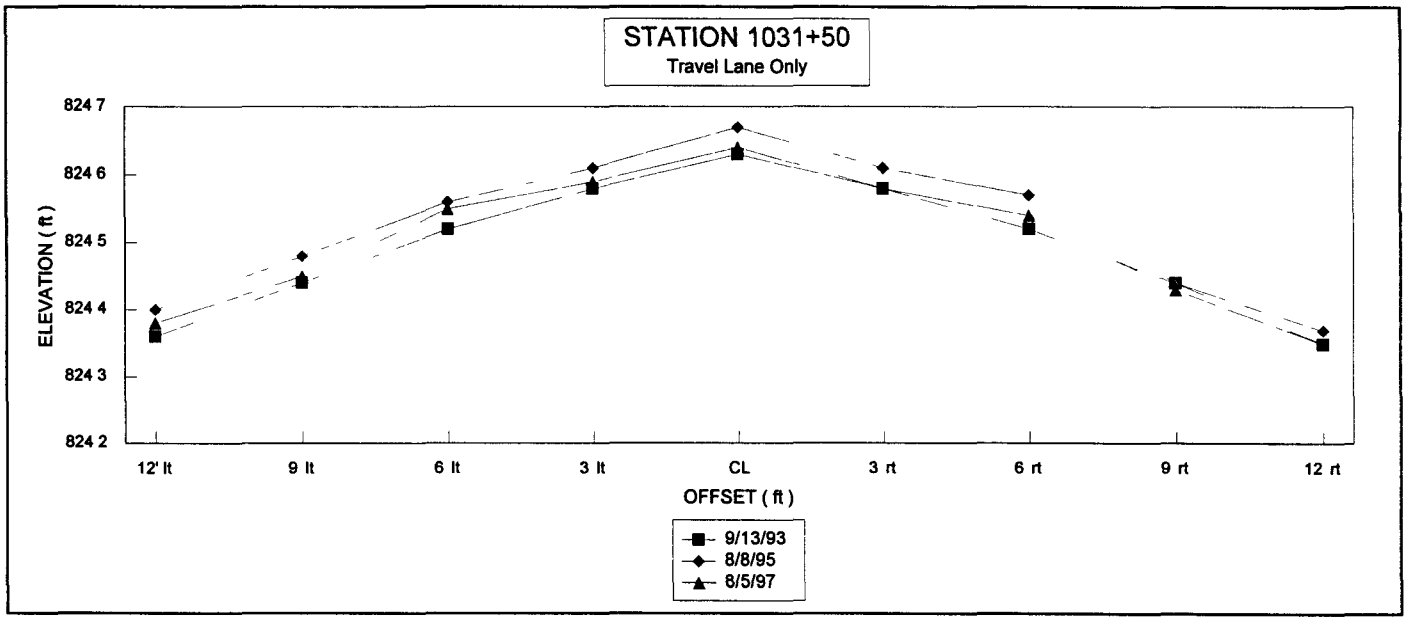


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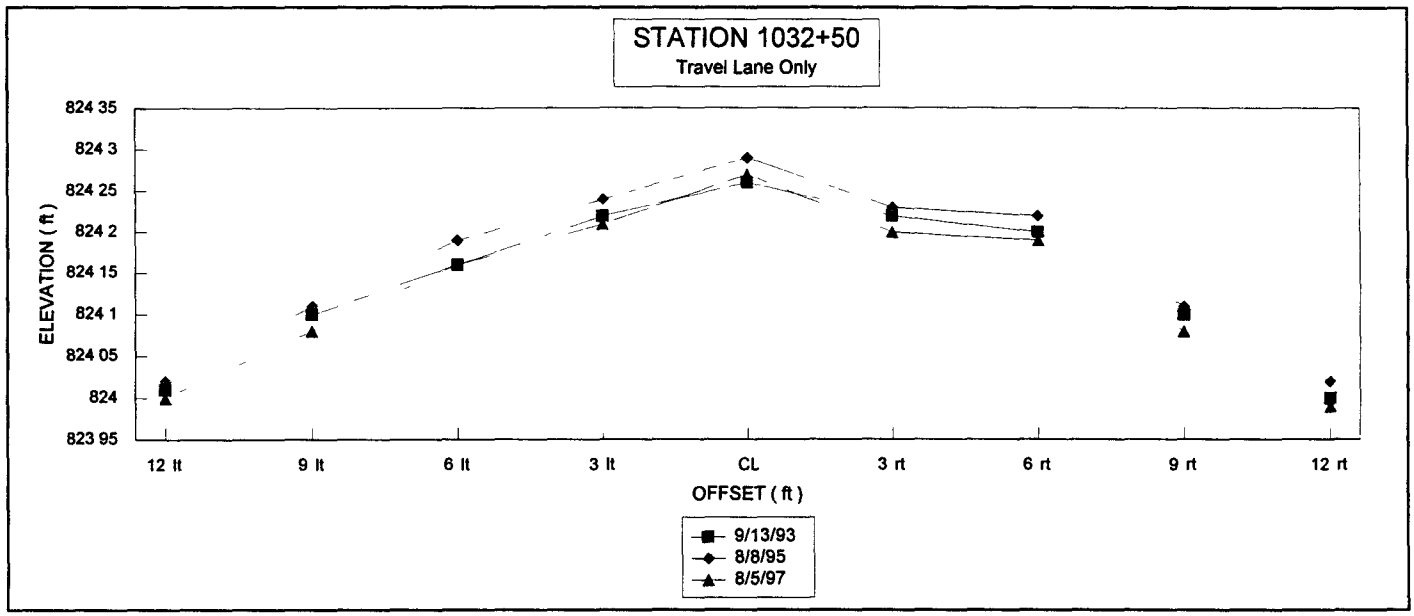
TABLE V
MDOT PROFILE AND ELEVATION SURVEY
(continued)
ASPHALT STABILIZED SECTION
STATION 1032+50

DATE	22' lt	12' lt	9' lt	6' lt	3' lt.	CL	3' rt.	6' rt	9' rt	12' rt	22' rt
8/22/91	823 58	824 04	M	M	M	824 28	M	M	M	824 04	823 62
6/30/92	823 54	824 01	M	M	M	824 28	M	M	M	824 01	823 60
9/13/93	823 54	824 01	824 10	824 16	824 22	824 26	824 22	824 20	824 10	824 00	823 56
8/8/95	823 62	824 02	824 11	824 19	824 24	824 29	824 23	824 22	824 11	824 02	823 59
8/5/97	823 59	824 00	824 08	824 16	824 21	824 27	824 20	824 19	824 08	823 99	823 57



STATION 1033+50

DATE	22' lt.	12' lt	9' lt	6' lt.	3' lt.	CL	3' rt.	6' rt.	9' rt	12' rt.	22' rt.
8/22/91	823 28	823 70	M	M	M	823 96	M	M	M	823 68	823 22
6/30/92	823 23	823 67	M	M	M	823 93	M	M	M	823 65	823 21
9/13/93	823 24	823 68	823 76	823 82	823 88	823 92	823 86	823 80	823 74	823 64	823 20
8/8/95	823 28	823 68	823 76	823 82	823 87	823 93	823 87	823 83	823 73	823 63	823 21
8/5/97	823 26	823 67	823 75	823 82	823 86	823 92	823 84	823 80	823 71	823 62	823 20

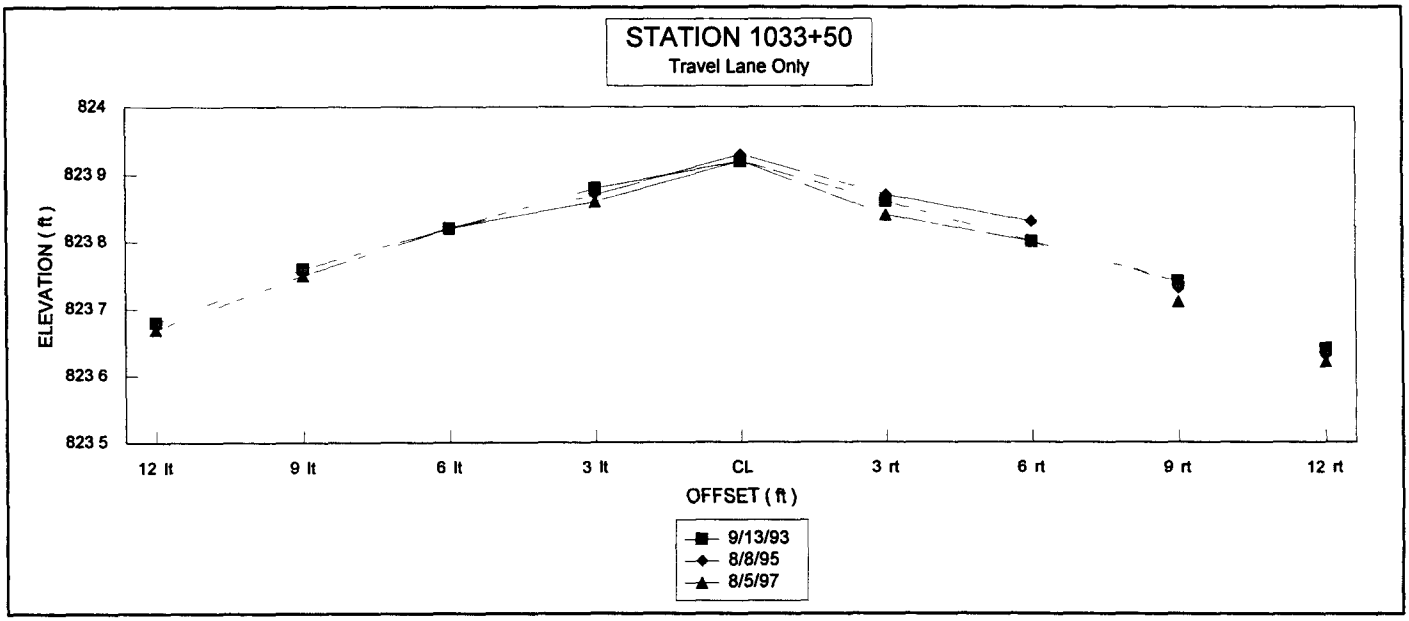


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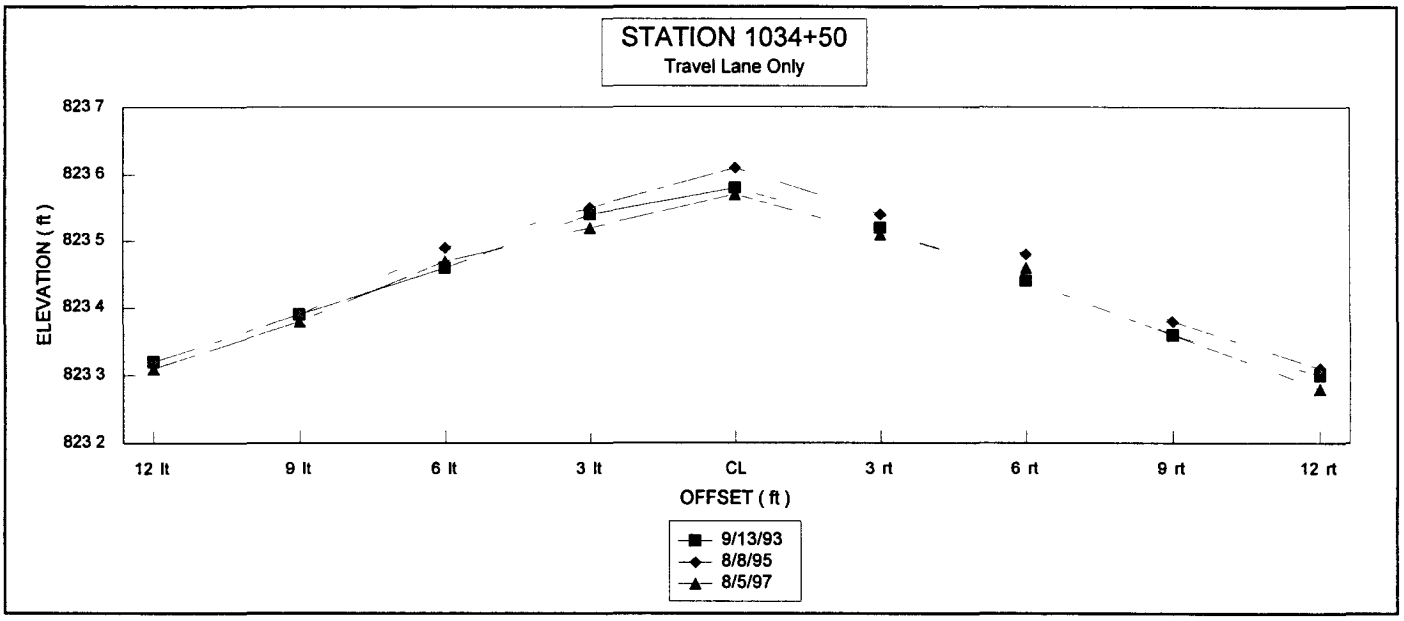
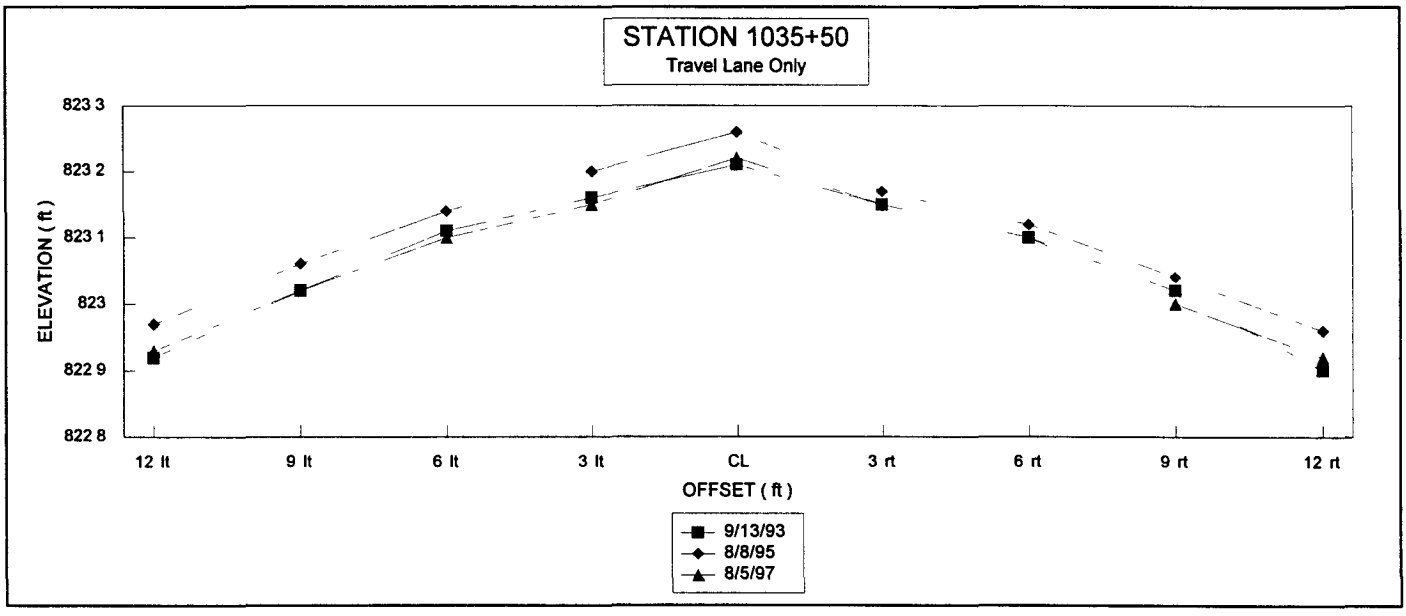
TABLE V
MDOT PROFILE AND ELEVATION SURVEY
(continued)
CALCIUM CHLORIDE STABILIZED SECTION
STATION 1034+50

DATE	22' lt.	12' lt	9' lt	6' lt	3' lt	CL	3' rt	6' rt	9' rt	12 rt.	22' rt.
8/22/91	822 90	823 34	M	M	M	823 62	M	M	M	823 34	822 86
6/30/92	822 87	823 31	M	M	M	823 59	M	M	M	823 29	822 82
9/13/93	822 84	823 32	823 39	823 46	823 54	823 58	823 52	823 44	823 36	823 30	822 82
8/8/95	822 89	823 32	823 39	823 49	823 55	823 61	823 54	823 48	823 38	823 31	822 79
8/5/97	822 88	823 31	823 38	823 47	823 52	823 57	823 51	823 46	823 36	823 28	822 80



STATION 1035+50

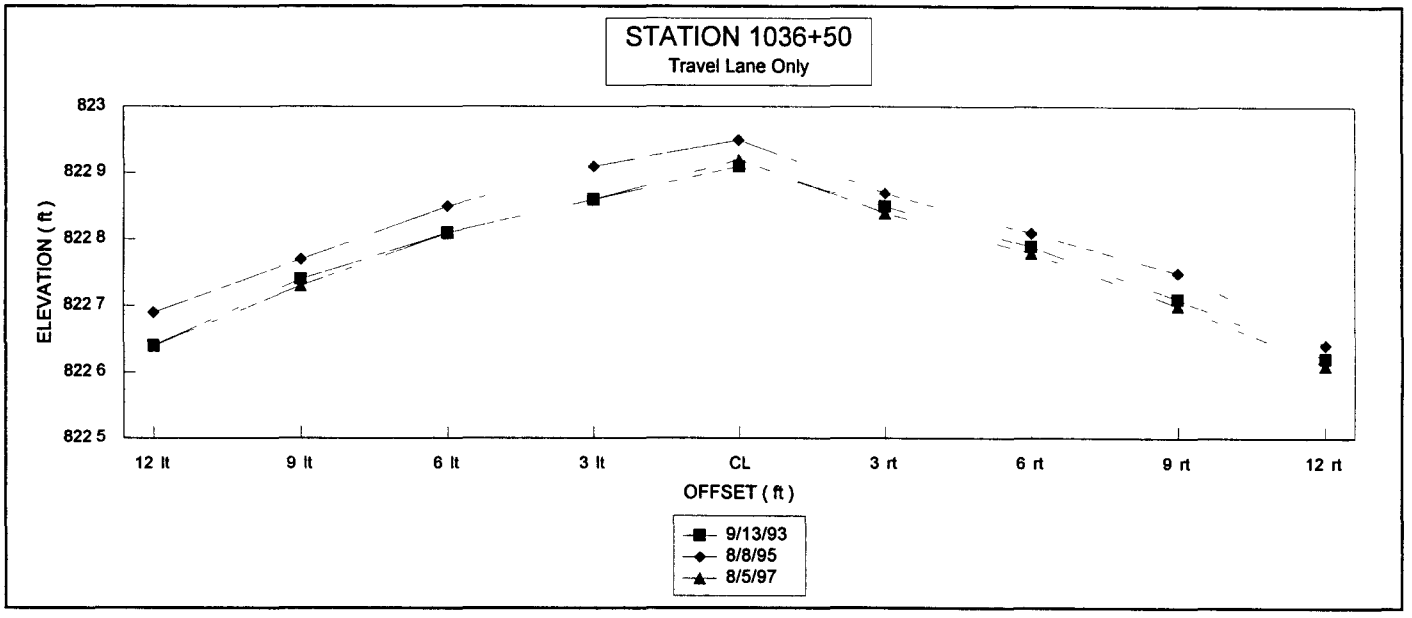
DATE	22' lt	12' lt	9' lt	6' lt	3' lt	CL	3' rt	6' rt	9' rt	12' rt	22' rt
8/22/91	822 54	822 96	M	M	M	823 26	M	M	M	822 98	822 56
6/30/92	822 52	822 93	M	M	M	823 23	M	M	M	822 93	822 53
9/13/93	822 48	822 92	823 02	823 11	823 16	823 21	823 15	823 10	823 02	822 90	822 50
8/8/95	822 54	822 97	823 06	823 14	823 20	823 26	823 17	823 12	823 04	822 96	822 51
8/5/97	822 50	822 93	823 02	823 10	823 15	823 22	823 15	823 10	823 00	822 92	822 50



M represents missing data

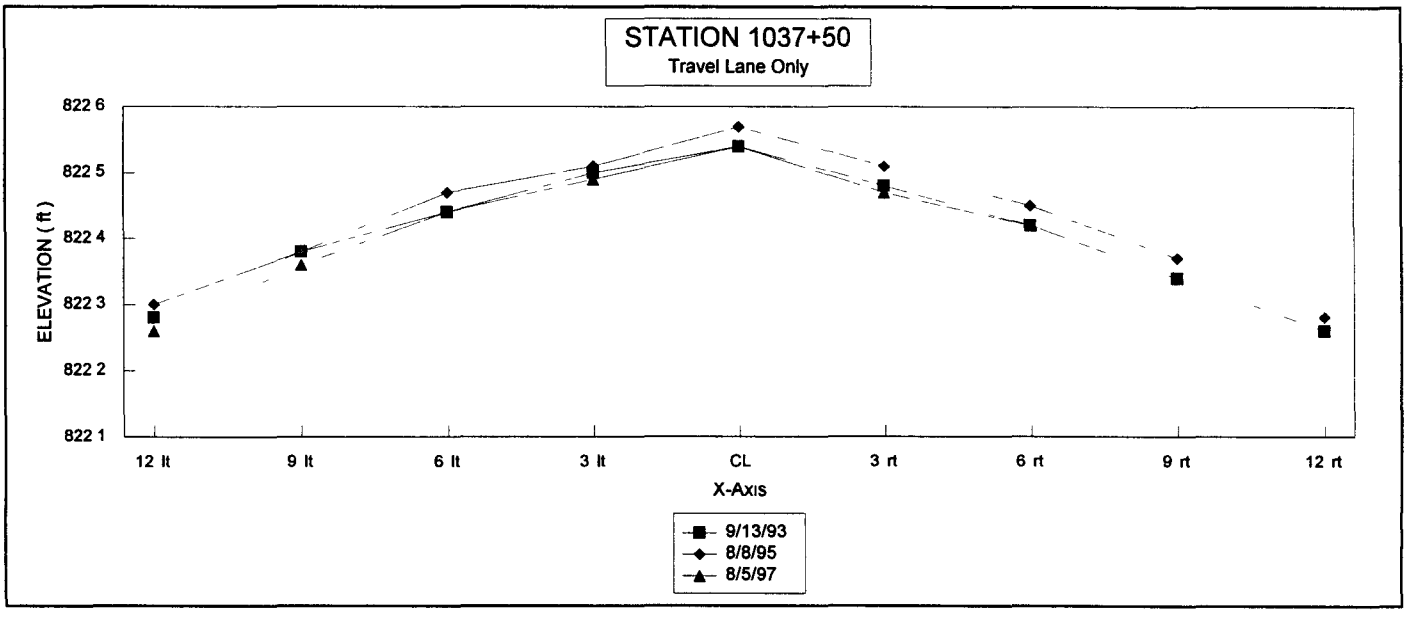
TABLE V
MDOT PROFILE AND ELEVATION SURVEY
(continued)
STANDARD SUBBASE CONTROL SECTION
STATION 1036+50

DATE	22' lt	12' lt	9' lt	6' lt	3' lt	CL	3' rt	6' rt.	9' rt	12' rt	22' rt
8/22/91	822 22	822 66	M	M	M	822 96	M	M	M	822 66	822 20
6/30/92	822 17	822 65	M	M	M	822 92	M	M	M	822 62	822 19
9/13/93	822 18	822 64	822 74	822 81	822 86	822 91	822 85	822 79	822 71	822 62	822 18
8/8/95	822 23	822 69	822 77	822 85	822 91	822 95	822 87	822 81	822 75	822 64	822 17
8/5/97	822 21	822 64	822 73	822 81	822 86	822 92	822 84	822 78	822 70	822 61	822 16



STATION 1037+50

DATE	22' lt.	12' lt.	9' lt	6' lt.	3' lt.	CL	3' rt	6' rt.	9' rt.	12' rt	22' rt.
8/22/91	821 88	822 30	M	M	M	822 58	M	M	M	822 30	821 86
6/30/92	821 86	822 28	M	M	M	822 55	M	M	M	822 27	821 84
9/13/93	821 86	822 28	822 38	822 44	822 50	822 54	822 48	822 42	822 34	822 26	821 85
8/8/95	821 90	822 30	822 38	822 47	822 51	822 57	822 51	822 45	822 37	822 28	821 83
8/5/97	821 87	822 26	822 36	822 44	822 49	822 54	822 47	822 42	822 34	822 26	821 84



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